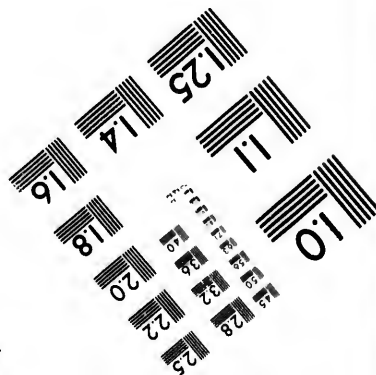
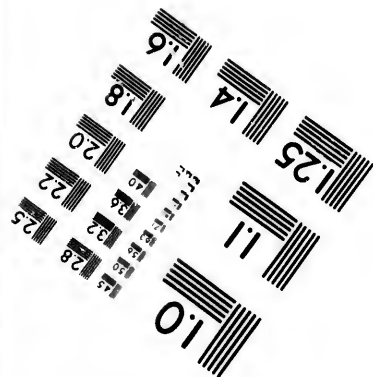
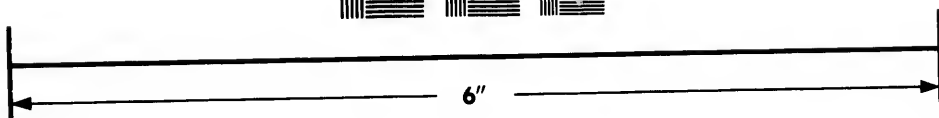
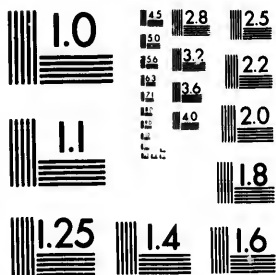


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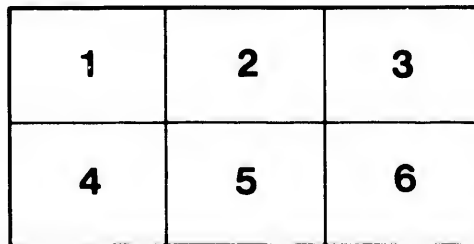
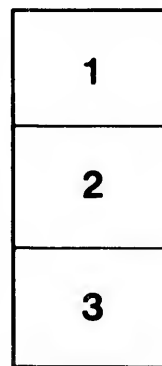
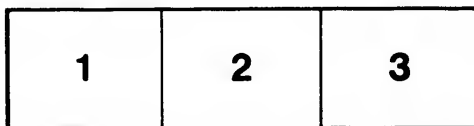
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DECEMBER 13. 1843.

The Rev. Thomas Image, M.A., was elected a Fellow of this Society.

The following communications were read : —

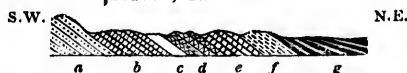
1. *On the GEOLOGY of CAPE BRETON.* By RICHARD BROWN, Esq.*

IN a letter to Mr. Lyell, dated Sydney Mines, Cape Breton, Oct. 20. 1843, the author stated —

“I have made a survey of some forty miles of coast on the eastern side of our coal-field; and have since devoted a few days to the examination of the shores of the Island of Boularderie, which is four miles wide, and twenty-six miles long, and exhibits natural sections on both sides from end to end. Nothing can be more definite than the position of the masses of gypsum in this island. I have examined them this summer in four different places, scores of miles apart, and find the following, with little variation, to be a section of the accompanying strata :

SECTION I. (Ideal).

General sequence of the COAL MEASURES and GYPSIFEROUS FORMATIONS near SYDNEY, CAPE BRETON.



- | | |
|---|--|
| † <i>g.</i> Coal measures. | <i>c.</i> Soft red shale. |
| <i>f.</i> Coarse sandstone with coal plants | <i>b.</i> Coarse concretionary limestone and shales. |
| —Shale. | <i>a.</i> Coarse conglomerate, highly inclined. |
| <i>e.</i> Limestone in thin beds—Fossils. | |
| <i>d.</i> Gypsum. | |

“Wherever I have had an opportunity of making observations, they have confirmed your views as to the relative age of the gypsum.”

Subjoined is the *Memoir* received from Mr. Brown.

THE following is a sketch of the north-western end of the Sydney coal-field. On the W. side of Sydney Harbour, the coal-measures can be traced transversely, without interruption, for 5200 yards, dipping to the N. E. at an angle of 7°, which gives a thickness of 1900 feet. The coal measures, generally speaking, are very free from faults.

* This paper and the next (Mr. Dawson's on Nova Scotia) are both illustrated by the map of Nova Scotia appended; but the map was originally prepared by Dr. A. Gesner to illustrate the paper of which a notice has already appeared in the “Proceedings,” vol. iv. p. 186. One portion of the map is repeated, and coloured according to Mr. Brown's survey.

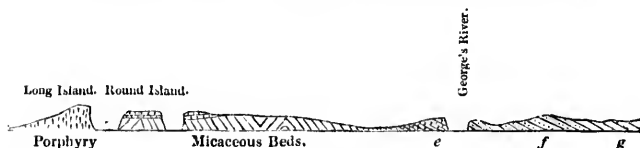
† These references are continued throughout the paper in the other Sections.

The coal-measures are underlaid by a series of sandstone beds, with some beds of shale. The thickness of the sandstone, in some places, exceeds 2000 feet; but to the west of the Little Entrance it is much thinner; and, finally, when it approaches the granite ridge that lies between the Great Entrance and St. Anne's Harbour, it has thinned out. The sandstones, with their superincumbent coal-measures, are very uniform in their dip to the north-east.

Next to the sandstone is the limestone; and this accompanies the sandstone very uniformly, along the whole course of its outcrop, from the southern branch of Sydney Harbour to the Granite ridge west of the Great Entrance. On both branches of Sydney Harbour, and at George's River, the limestone dips distinctly beneath the sandstone. The shore, from George's River to Long Island, gives the following Section,

SECTION II.

LONG ISLAND to the COAL MEASURES East of GEORGE'S RIVER.



First we have the limestone (*e*); then a low, flat space of half a mile, where the stratification cannot be observed; then beds of a red and brown micaceous slaty rock, dipping at high angles in various directions between south and west.

The base of Round Island is of the same kind of rock; but the Isle is capped with a limestone which, to judge from its fossils, is quite different from the limestone * above described beneath the sandstone. Long Island, on its eastern side, is 200 feet high, and very precipitous; but, in a westerly direction, it slopes gradually to the water. It is composed principally of Porphyritic rocks.

On the opposite side of the channel, the shore exhibits the following section:—

SECTION III.



First, the sandstone (*f*) which underlies the coal-measures, and can be traced to within a few hundred yards of Roe's Point.

At Roe's Point the limestone (containing here *Productus Lyelli*) shows itself, having an easterly dip. This limestone, both in its local position, dip, and general appearance, corresponds with the limestone on the other side of the channel, at George's River;

* This limestone contains *Terebratula elongata*, and a *Modiola*.

and these circumstances lead to the supposition that in both instances it dips under the sandstone. Between Roe's Point and Campbell's Cove, on the western shore of the Island of Boularderie, the strata are very much broken and disturbed by faults. It would be difficult to describe these disturbances by words; but the Section will give the most distinct idea of them. Gypsum appears along this line in two places, which are shown in the Section.

First, to the N. W. of Roe's Point, we have solitary pinnacles of gypsum appearing on the beach. Next, three beds of limestone, with two of sandstone interposed, these beds all dipping in an opposite direction to those at Roe's Point. The middle bed of limestone contains *Productus spinosus*. The third and upper of these limestones is cut off by a vertical fault, which is succeeded by a flat arch of limestone, resting upon sandstone. This again is cut off by a vertical fault, which is succeeded by a horizontal bed of limestone.

This is followed by a level space; and beyond that we have a series of beds dipping in the same direction with those of Roe's Point.

- | | |
|-------------------------------------|---|
| 1. A thin bed of limestone. | 5. Rich marl, 6 feet. |
| 2. A bed of sandstone. | 6. Green sandstone, with veins of gypsum, 2 feet. |
| 3. A thick bed of coarse limestone. | 7. Red marl, with grains of gypsum, 12 feet. |
| 4. Gypsum, 18 feet thick. | |

This is followed by a level space, when no beds are seen, and beyond that we have limestone, dipping in the same direction with the gypsiferous marls.

SECTION IV.

CAMPBELL'S COVE, near LIME POINT.



Proceeding from Campbell's Cove along the shore of the Island of Boularderie in a south-westerly direction, we have similar limestones, lying in a horizontal position, for the space of two miles, until we arrive at Lime Point, where a small cove exhibits three beds of limestone with two interposed beds of sandstone dipping to the S. S. E., and apparently underlying the sandstone with coal-plants; but separated from it by a space which affords no section. The lowest of the three beds of limestone contains *Spirifer glaber* (Lyell); the middle bed contains shells.

The writer mentions in his letter to Mr. Lyell that, "on the eastern side of the Sydney coal-field, he has found below the coal-seams, in every instance, beds of fire-clay, containing the long fibrous leaves of *Stigmaria*, matted together.

"In the black bituminous Shale, which lies about twenty yards

above the Main Coal at Sydney, he has found the scales of different kinds of fishes, as hard and bright as enamel; one tooth, and a number of Coprolites; also the *Cypris* in great abundance, and a *Modiola*."

2. *On the LOWER CARBONIFEROUS ROCKS, or GYPSIFEROUS FORMATION of NOVA SCOTIA.* By JOHN WILLIAM DAWSON, Esq., of Pictou, Nova Scotia.*

THE coal formation of the eastern part of Nova Scotia consists of a great thickness of sandstones, shales, and conglomerates, of various reddish and grey colours, the former being most prevalent. The lower part of the series is distinguished by the presence of limestones with marine shells and gypsum. The central portion is characterised by a greater prevalence of grey and dark colours, and by containing an abundance of vegetable fossils and beds of bituminous coal. The upper portion of these productive coal measures appears to pass into a thick deposit of reddish sandstones and shales, containing few fossils, either animal or vegetable. To examine the structure and relations of the lower, or gypsiferous part of this series, is the object of the present paper: it will, however, be proper in the first place to notice the general disposition of the rocks of the Carboniferous system, in the region more particularly observed, which extends along the shores of the Gulf of St. Lawrence, from Tatmagouche to Antigonish Harbour.

The coast section between these points cuts at acute angles across two great coal troughs, the one beginning at Pictou, and thence stretching to the west along the northern shore of the Basin of Mines; the other beginning at Antigonish, and thence extending westward to the Stewiacke and Shubenacadie Rivers. These two troughs are separated by a hilly range composed of igneous rocks and of disturbed lower-carboniferous and Silurian strata. This range beginning at Cape St. George extends westward to the East River of Pictou; and beyond this it is continued along the outcrops of the oldest carboniferous rocks in the direction of Truro.

The southern boundary of the Antigonish trough is formed by the region of Palæozoic, metamorphic, and Plutonic rocks which occupy the southern side of the province. A chain of hills, similar in structure to the range of Cape St. George, but of greater elevation, separates the Pictou trough from a region belonging to the coal strata which extends beyond Tatmagouche in a northerly direction.

The chain in question commences at the New Annan Hills, and extends westward through the Cobequid Mountains† to the Bay of

* See the map of Nova Scotia.

† Dr. Gesner, many years since, described the Cobequid chain as forming a ridge separating the coal-formation of the north side of the Basin of Mines from that of Cumberland county. Mr. Logan first noticed the existence of a trough of carboniferous strata between Antigonish and Windsor.

SECTION I.

TATMAGOUCHE TO TRURO, 24 miles.



- d. Horizontal red sandstone.
- c. Red and grey sandstones and shale, with concretionary limestone, containing copper ore, *liguite*, *Endogenites*, and *footmarks of birds*; dip near the hills, 30° ; at Tatmagouche only 10° .
- b. Sandstone and coal—*coal-plants*.
- a. Limestone, dark slate, shale, and grits, with shells and *encrientes*—Intruding bands of granite, syenite, amygdaloid, &c.

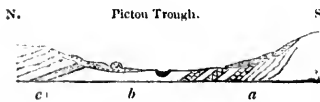
Fundy. To the eastward it does not reach the coast of Northumberland Strait, though its underground continuation in that direction is indicated by an Anticlinal line which traverses the newer members of the coal formation that lap round the eastern extremity of the Annan Hills.

These trough-shaped arrangements of the strata are subject to many irregularities. The hilly region of Mount Thom is placed nearly transverse to the Pictou trough. In consequence of the separating ridges and anticlinal lines having been elevated, either during the carboniferous period, or at a still later epoch, the carboniferous strata are traversed by numerous faults and minor lines of disturbance, the prevailing direction of which is from east to west. In spite of these disturbances, however, the strata in the troughs have a general synclinal arrangement which can be traced in the hilly regions, such as that of Mount Thom. This will be seen by examining the accompanying map.

East River.

SECTION II.

Valley of the eastern branch of EAST RIVER.



- c. Hard sandstone.
- b. Gypsiferous formation, with beds of limestone and gypsum alternating, and drifts overlying.
- a. Silurian slate.

gypsum (b). These latter are seen in the valley of the river between the sandstones and the Silurian strata (a); but there are no good

The gypsiferous formation appears in several places on the south side of the Pictou coal trough. In noticing its appearance at these points, I may begin by stating some facts respecting the section on the East River of Pictou in addition to those already described by Mr. Lyell. The members of the gypsiferous formation seen in that section consist of hard, brownish-red shales and sandstones (c), with beds of marine limestone and masses of

sections to be found in the neighbourhood. With the view of ascertaining their true relations, I examined two gypsum rocks, within three miles of that seen by Mr. Lyell. The first of these consisted of white granular gypsum, containing, like most similar beds in this province, minute disseminated grains of carbonate of lime, and having, in one part, large rounded masses of anhydrous gypsum, enclosed in the common species, an appearance which I have not elsewhere observed. No other rock was seen in connection with this bed, which appeared to be upwards of 100 feet thick, and to have a strike corresponding with that of the nearest visible sandstones and limestones. The other bed examined was on Lime Brook, a tributary of the East River. Here there is no good section, but the gypsum may be seen in connection with soft sandstones mostly white, and having limestones both below and above, separated, however, by intervals without section, which have probably once been occupied by soft sandstones removed by denudation. The limestone, underlying the gypsum at Lime Brook, is without fossils, and rests unconformably on the edges of slates with Silurian fossils, angular fragments of the slate being included in its lower portion. The limestone above the gypsum is of a lighter colour, and more pure than any other limestone on the East River, and is also distinguished by containing a species of coral, not found in the other beds. These limestones are seen at several other points, apparently resting on the older slates; and in some places appear to be penetrated by fissures containing hæmatite and other ores of iron, peroxide of manganese, and sulphate of barytes.*

The limestones and gypsums thus resting on the Silurian strata at the East River are separated from the productive coal measures by hard reddish sandstones and shales, apparently of great thickness, and containing (especially in their lower part) beds of marine limestone. Where they approach the coal measures, however, the sandstones are very much disturbed, and for this reason I was anxious to obtain some additional evidence of the actual superposition of the coal measures. I therefore examined the section shown by the Middle River, and found there a series of beds dipping in the same direction with those at the Albion mines, though at a higher angle, and beginning at about 5000 feet below the main coal at the Albion mines. The uppermost of these rocks is a thick bed of hard grey sandstone; underlying this are alternations of grey and reddish sandstones and shales, containing in one place a bed of bituminous shale, with *Calamites* above, and cylindrical leaves or roots, perhaps of *Stigmaria*, below. Beneath these are several hundred feet of red and variegated sandstone, with shale and conglomerate. Here there is a break in the section,

* The balls of hæmatite scattered over the country, near the gypsums of the East River, have been derived from these fissures in the gypsiferous rocks; and their abundance is an additional evidence of the denudation which these rocks have suffered.

and these rocks are succeeded, further up the river, by disturbed sandstones and limestones, which I was unable to examine, but which I believe to correspond with those of the East River.

From these observations, in connection with those formerly made by Mr. Logan and Mr. Lyell, it is apparent that the lowest members of the Carboniferous series seen on the East River consist of limestones, gypsum, and soft sandstones, above which are hard reddish sandstones and shales, with limestone; and lastly, red and grey sandstone, shells, and conglomerate, with carboniferous plants, and probably these beds pass into the productive coal measures.

On the south side of the West River of Pictou, limestones, having the same fossils with those found on the East River, are seen in several places, and are associated with reddish sandstones, hard grey shales, and white and purple sandstones. Farther westward, near the Salmon River, there are sandstones, limestones, and gypsum, identical in fossils and mineral character with those of the East River, and like them connected with productive coal measures, which they appear to underlie. Still farther westward, the gypsiferous formations of Onslow and the De Bert River probably form a continuation of the Pictou lower carboniferous deposits, being, like them, succeeded to the northward by the middle and newer members of the coal formation.*

Merigonish.

SECTION III.

MERIGONISH TO MALIGNANT COVE, 20 miles.



e. Coloured sandstones and shales, with occasional bands of ironstone and concretionary limestone in the upper part—*Calamites* and other coal plants. Coal?

d. Limestone and conglomerate—*fossil shells*.

c. Amygdaloid and conglomerate overlying sandstones and containing *plants*.

b. Dark shales with thin beds of limestone, a little conglomerate, and reddish grits—*marine shells*, *Encrinites*, *Trilobites*, &c.

a. Altered red sandstone and conglomerate with dark shales, beds of amygdaloid, and intruding masses of greenstone.

Eastward of the East River, the band of carboniferous rocks included between the shores of the gulf and the hills to the southward, shows a series of beds, amounting to 10,000 or 12,000 feet in thickness, and dipping to the north-west at an angle of 20 degrees. The upper part of this section, beginning at the entrance of Meri-

* The salt springs of the West River rise from lower carboniferous rocks, those of Salmon River from the productive coal measures. In both instances they rise from vertical strata on lines of fault.

gonish harbour, shows grey and brownish-red sandstones and shales, buff-coloured sandstones, impure iron-stone, and coarse concretionary limestone, these beds containing Calamites, coniferous wood, and one or two small beds of coal. This part of the section is, however, very imperfect, though, wherever the rocks can be seen, there is a perfect conformity of dip. Their general aspect and fossils correspond with those of the middle part of the coal-formation, and they occupy about six miles of the coast section.

Eastward of the rocks last described, the section is better, and shows a great thickness of brownish-red sandstones and shales, with some grey beds, in which I could not find any fossils, except some carbonised fragments of plants. These strata occupy about three miles of the section, and are underlaid by reddish conglomerates, containing two beds of dark grey limestone, having an aggregate thickness of about 80 feet. These limestones contain numerous fossils, among which are *Productus Martini*, *Spirifer glabra*, and other shells, all common to these beds and the limestones of the East River. These conglomerates and limestones are succeeded by a few hundred feet of thinly stratified, reddish and grey sandstones, with a few fragments of fossil plants in bad preservation. Beneath these, red conglomerates again appear, associated with amygdaloidal trap. The latter is of a grey colour and earthy aspect, and has its cells filled with white carbonate of lime. It constitutes two conformable beds, whose lower sides are more compact than their upper. Their upper surfaces are also partially broken up and intermixed with conglomerate. At this point the carboniferous rocks are cut off on the coast section; some hard brownish grits, however, seen in a neighbouring brook, called McCara's brook, probably underlie the rocks last mentioned.

The section between McCara's brook and Arisaig is occupied by dark shales and thin layers of limestone, with a few beds of reddish shale and conglomerate. These rocks dip S. W., but become much fractured as they approach Arisaig. They contain numerous fossils, including species of the genera *Tentaculites*, *Graptolites*, *Trilobites*, *Orthoceratites*, *Modiola*, *Productus* and *Conularia*, and remains of *Enerinites*. Though mostly Silurian, a few of these species appear to be the same with those of the slates of the East River. Rocks having the appearance and fossils of the latter are, however, found a short distance inland, to the southward of the shales.

There can be little doubt that, in the sandstones, limestones, and conglomerates of this section, we have the representatives of at least a part of the Gypsiferous formation of the East River, and, resting conformably upon these, an equivalent of the coal-measures.

Arisaig.

At Arisaig, 15 miles from Merigonish harbour, we enter on the disturbed district, separating the coal-trough of Pictou from that of Antigonish. From Arisaig to Malignant Cove, the shore

stones and coarse coniferous beds can be seen from the coal-section.

better, and shales, hills, except occupy about conglomerate having anes contain *Spirifer* and the lime-limestones bed, reddish plants in bad in appear, grey colour carbonate of er sides are es are also e. At this st section; ring brook, mentioned.

is occupied few beds of S. W., but they contain *Pentaculites*, *Productus* and Silurian, of the slates d fossils of and, to the

limestones, entatives of East River, f the coal-

re enter on Pieton from e, the shore

displays hard brownish-red quartzose and jaspery rocks, with thick beds of hard grey shales, red conglomerates, and coarse purplish grits. Associated with these, are beds of amygdaloid, which are evidently interstratified with the accompanying rocks, and are probably, like those of M'Cara's brook, of contemporaneous origin. The whole of these beds are vertical, and are, without doubt, lower carboniferous rocks (perhaps a little lower in the series than those last seen at M'Cara's brook), but in a much altered condition. Beyond Malignant Cove, syenitic greenstone is seen on the shore, and, is said to appear in different places as far as Cape St. George. Eastward and southward of Malignant Cove, the hills, in many places, show masses of compact felspar and other igneous rocks, accompanied by altered and disturbed grits. After passing this disturbed region, we enter on the Gypsiferous rocks of the northern side of Antigonish harbour, having a general dip to the southward. Of these rocks, I examined two interesting sections.

Antigonish.

SECTION IV.

RIGHT'S RIVER, ANTIGONISH.



- d. Gypsiferous beds—gypsum, limestone, and sandstone.
- c. Limestone.
- b. Red conglomerate and coarse red sandstone, dark sandstone and shale.
- a. Dark and grey sandstones and shales, reddish sandstone: —plants.

The first of these sections is that represented above, and is seen extending about five miles. Near the mouth of this river, at the head of Antigonish harbour, is a thick bed of white gypsum, dipping to the south-west. Succeeding this, in descending order, after a small interval (which appears to have been occupied by sandstones, now nearly removed by denudation), is a bed of dark-coloured limestone, in which, at different points where it appears, I found *Productus Martini* with other shells also occurring on the East River; and *Productus Lyelli*, a shell not yet met with in the East River limestones, but very characteristic of the gypsiferous formation in other parts of the province. Below this limestone there is another break, also showing traces of sandstones and a bed of gypsum, and then a thick bed of dark limestone, partly laminated and partly brecciated without fossils, and containing in its fissures thin plates of copper ore. Beneath this limestone is a great thickness of reddish conglomerate, composed of pebbles of igneous and metamorphic rocks, and varying in texture from a very coarse conglomerate to a coarse-grained sandstone. In one place it contains a few beds of dark sandstones and shales. These are succeeded by red, grey, and dark sandstone and dark shales, in a disturbed condition, but probably underlying

the conglomerate; they contain a few fossil plants. This section on Right's River includes a thickness of probably 8000 feet.

SECTION V.

OGDEN'S LAKE TO SOUTH LAKE, near ANTIGONISH (4 miles).



- d. Grey sandstone, and red conglomerate.
- c. Soft red sandstones and clays; *lignite*, *calamites*, &c.
- a. Altered dark sandstones and shales; intruded greenstone.
- b. Grey and soft red sandstones and shales.
- e. Limestone.
- f. Gypsum.

Another section, near the mouth of Antigonish harbour, displays a series somewhat similar. At the north side of the outlet of Ogden's Lake, about eight miles from Antigonish, is a bed of gypsum, probably nearly 200 feet in thickness. Its upper part is composed of white granular gypsum, in thick laminae, and with disseminated particles of carbonate of lime. Beneath this is a considerable thickness of foliated red gypsum, in its lower part alternating with layers of a grey argillaceous non-crystalline limestone, on which it rests, and which is penetrated by small veins of white fibrous gypsum in its upper portion, while below it becomes brecciated, and then laminated. It is probably 100 feet thick, and appears to contain no fossils. These great beds of gypsum and limestone dip to the S. S. E. at an angle of 25° , and rest unconformably on soft red sandstones and shales, with some grey sandstones and reddish conglomerate, dipping nearly in the same direction, but at an angle of 50° . Following this underlying series in the descending direction, it becomes more highly inclined, and is finally vertical, resting against a mass of altered and contorted dark shales and sandstones, with veins of greenstone containing much epidote. This part of the section is connected with a ridge of igneous rocks running in an east and west direction, and which a few miles farther inland attains a considerable elevation. It consists of a reddish syenite, quartz, compact felspar, and greenstone. After passing these disturbed rocks, there is a break in the section, which is next occupied by thick beds of brownish-red sandstone and clay, supporting a thin bed of conglomerate and some thick beds of grey sandstone, containing *Calamites*, *Sternbergia*, *Endogenites*, *Carpolites*, and pieces of lignite. The relations of these beds to the other parts of the section I could not determine. They dip to the north-east, and probably belong, either to the upper part of the gypsiferous formation, or to some newer member of the coal series.

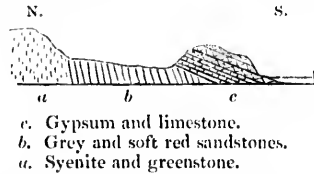
These sections differ from that of the East River of Pictou, chiefly in the presence of large masses of sandstone and conglomerate beneath the limestones, and in the non-appearance of the thick series of sandstones above the gypsum, so conspicuous in the Pictou sections.

Shubenacadie.

Having thus described the Lower Carboniferous rocks, as they appear in some of the best sections near the Gulf of St. Lawrence, it may be interesting to compare their arrangement and lithological character with those of the Gypsiferous formations of the central part of the province, formerly supposed to be newer than the coal-formation, but referred by Mr. Lyell, principally on the ground of its fossils, to the lower part of the Carboniferous system. The rocks seen on the estuary of the Shubenacadie furnish a good specimen of these deposits for the purpose of comparison. The sections on this estuary show several extensive masses of stratified deposits, differing considerably in their mineral character, and separated by faults in such a manner that their true relations do not appear. Most of these masses consist of Red sandstones and marls, with beds of gypsum and limestone. These, when compared with the corresponding rocks in the Picton and Antigonish sections, appear to differ only in their apparently greater mass, and especially in the thickness of the deposits of red sandstone and marl. The upper bed of gypsum on Right's River is succeeded by a level tract affording no section; and from the two sections, representing the outline of the surface near the gypsum of Ogden's lake and the East River, it will be seen that the present outline of the surface is caused by a great removal of the softer beds.

SECTION VI.

NEAR OGDEN'S LAKE, ANTIGONISH (showing deauration).



One of the most remarkable rocks on the banks of the Shubenacadie is a great bed of compact and laminated non-fossiliferous limestone, near the mouth of the estuary. This bed has its upper surface broken up into a kind of breccia, and supports a great thickness of soft red sandstone and conglomerate, with beds of gypsum. It is also traversed by fissures filled with hematite and ores of manganese. It rests upon a great thickness of hard, brownish grits and shales, which appear in different places on the road from Shubenacadie to Truro. The horizontal red sandstone of Truro rests on the edges of these grits, which, near Truro, become either vertical or dip rapidly to the north-east, and perhaps also underlie some of the gypsiferous rocks of the Onslow hills. From a consideration of all these circumstances, it appears probable that these hard grits are the equivalents of the lower grits and conglomerates of Antigonish; and that the bed of limestone which

they support is a representative of the lower limestone at Antigonish and Pietou. To the lower grits I would also refer the mass of dark red sandstones and shales at Eagle's Nest, three miles from the mouth of the estuary of the Shubenacadie. The mass of contorted dark sandstones and shales at Five-mile River resembles some parts of the productive coal formation more nearly than any of the lower carboniferous rocks: and the horizontal red sandstone, a few miles farther up, is analogous to many of the beds both above and below the gypsum at Antigonish and Pietou.

From a comparison of the appearances of the lower carboniferous rocks in the various sections which I have examined, I have drawn out the following table, which, I think, exhibits very nearly their general arrangement. It commences with the productive coal measures.

Lower Carboniferous or Gypsiferous Formation.

Rocks.	Fossils.	Where seen.
1. Brownish-red, mottled and grey sandstones; brownish-red shales; some conglomerates; the beds containing small quantities of copper ores.	Endogenites, Calamites, Lepidodendron.	Merigonish, East River, Middle R., Shubenacadie?
2. Brownish-red hard sandstones and shales, often rippled; some grey sandstones, conglomerates, and limestones; copper ores in small quantity.	Fragments of plants and fucoidal markings; <i>Productus</i> (especially <i>P. Martini</i>), <i>Terebratula</i> , <i>Spirifer</i> , and other shells.	East River, Merigonish, West River, Middle River, Economy, Wardrobe's, on Shubenacadie?
3. Reddish and white sandstones and marls, usually soft; beds of gypsum and limestone (the lowest bed usually a non-fossiliferous limestone); veins and fissures with ores of iron, manganese, copper, &c.	<i>Productus</i> (especially <i>P. Lyelli</i>), <i>Terebratula</i> , <i>Enerinites</i> , Corals, <i>Spirifer</i> , <i>Pecten</i> , <i>Avicula</i> , &c. &c.	East River, Antigonish, Shubenacadie, Onslow Mountain, De Bert R., Windsor, Pugwash, Wallace, &c.
4. Reddish-brown conglomerates and hard grits; some dark and grey sandstones, and brown and dark shales.	Various plants.	Antigonish, Shubenacadie, Truro, Salmon R.

Newer Coal Formation, Sandstones, &c.

In several parts of the eastern section of Nova Scotia, there are extensive deposits of sandstones and shales, principally of a brownish-red colour, and including some thin beds of concretionary limestone and grey sandstone. They contain a few calamites and other carboniferous plants. These beds constitute, I believe, the newest member of the carboniferous series, and are connected with the productive coal measures by a thick series of reddish-brown and grey sandstones, shales, and conglomerates, often abounding in

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

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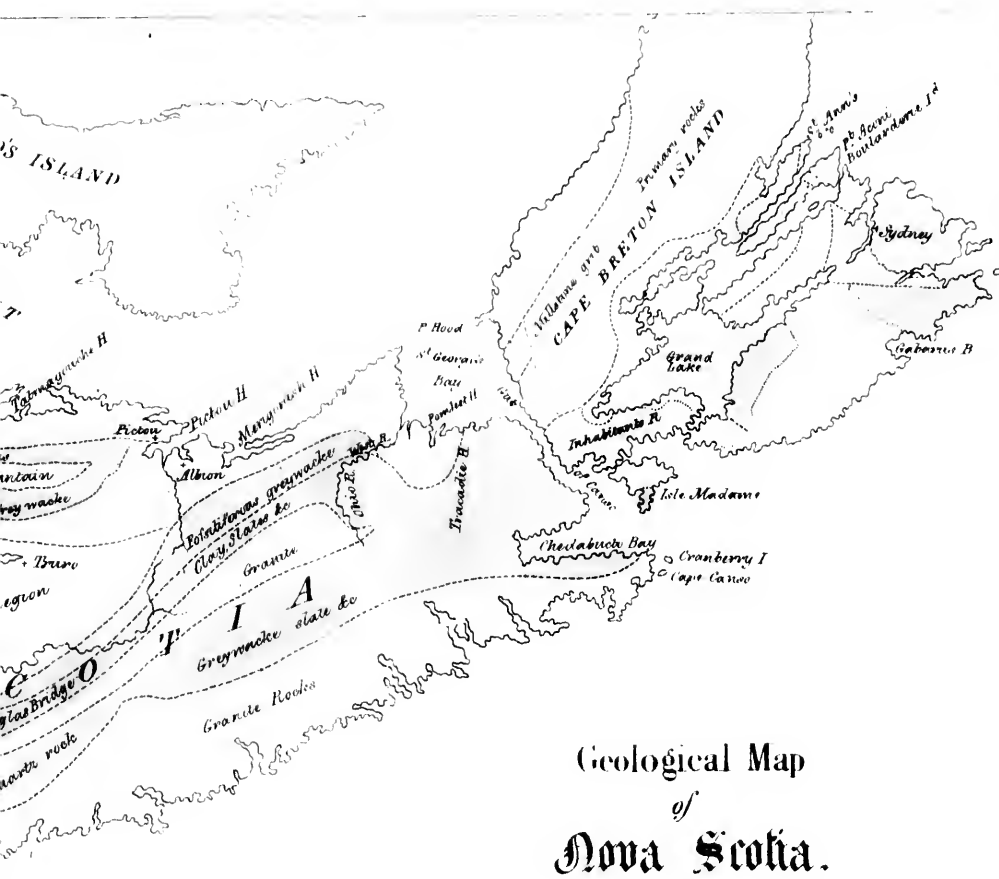
Geological Map
of
Nova Scotia.
by
D.^R A. GESNER.

-  *Igneous Rocks.*
-  *Metamorphic & Silurian.*
-  *Old red sandstone & Gypsiferous series.*
-  *Coal Measures.*

Cape Breton,
from Messrs Pauson & Brown's Surv

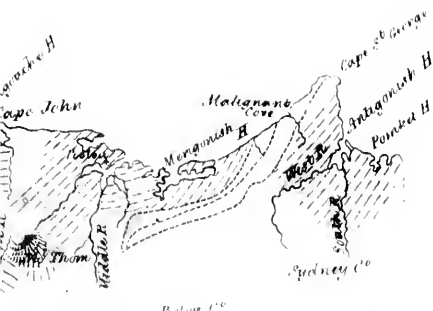


Bellevue
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Geological Map
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- Igneous Rocks.
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- Coal Measures.



Portion of Nova Scotia from W. Dawson's Survey Strike

Cape Breton, from M^{rs} Dawson & Browns Survey

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fossil plants. As these upper red sandstones have, however, been confounded with the gypsiferous formation, some of whose sandstones they often much resemble, I may shortly describe a section on the Waugh's and French rivers of Tatmagouche, exhibiting a portion of them, and at the same time illustrating the structure of a part of the Cobequid chain.

At the mouth of the French river are grey sandstones and shales, containing a few endogenites, calamites, and pieces of lignite, impregnated with copper ores. Beneath these appears a series of brownish-red sandstones and shales, with a few grey beds, occupying, in a regular descending series, about six miles of the river section. They contain, in a few places, nodules of copper glance, they are often rippled, and contain branching fucoidal marks. On one of the rippled slabs I found marks consisting of four foot-prints of an animal. These were three inches and a-half apart, and each exhibited three straight marks, as if of claws.*

The dips of these sandstones gradually increase in approaching the hills, and the lowest seen is a bed of grey sandstone, dipping at an angle of 30°. There is then a small break in the sections, succeeded by hard dark shales and slates, and hard brown grits, with a bed of limestone in which I could find no fossils, except a fragment of a *Productus* and a few fragments of encrinital stems in bad preservation. These rocks are much disturbed, but generally appear to dip at high angles to the northward. They are associated with masses of greenstone, amygdaloid, reddish syenite, and other igneous rocks. They appear to rise unconformably from beneath the sandstones of the low country; but whether they belong to the lower carboniferous or to some older system, I cannot at present determine.

I hope, at some future time, to be able more particularly to state the structure and relations of the newer members of the coal formation, but have not yet collected a sufficient quantity of facts to determine accurately their relations.

The horizontal red sandstone of Truro, which skirts the Basin of Mines, has no connection with the red sandstone of Tatmagouche, but is probably newer than any part of the coal formation. It is destitute of the grey sandstones and shales, and in several sections of it which I have examined, I have not found any fossils.

3. On CONCRETIONS in the RED CRAG at FELIXSTOW, SUFFOLK.

By the Rev. J. S. HENSLOW, M.A., F.G.S., Professor of Botany in the University of Cambridge.

I PLACE on the table a selection from a large assortment of a peculiar description of concretions obtained from the Red Crag at

* These tracks resemble the marks of the claws of an animal *running* over a moderately firm surface, or *climbing* up an inclined plane. They are not unlike the marks left by the claws of small individuals of the River Tortoise on the sides of mud banks, but differ from them in showing traces of two feet only.

Felixstow, in Suffolk. In 1842 I was much puzzled to account for the nature of these concretions. At a cursory glance one might almost be inclined to pass them by as waterworn pebbles, as they lie abundantly interspersed among the comminuted shells which form the upper parts of the cliffs. I found more than one eminent geologist disposed to agree with me in considering them to be rolled masses of London clay which had been indurated subsequently to their deposition in the crag. On my again visiting Felixstow during the summer of the present year (1843), I determined to give them a particular examination; and although a formation which has been so thoroughly worked as the crag is not likely to afford a casual visitor the opportunity of gleanings much of novelty, I believe I have satisfactorily ascertained the origin of these concretions, and have added to the list of crag fossils the petro-tympanic bones of at least four species of Cetaceans. These latter, I am persuaded, have been overlooked among the many concretions of this formation. They are, however, of a different composition, and closely resemble, in this respect, the silicified fragments of bone so abundant in this locality. I believe the specimens I have procured will range under two types, each containing at least two species. I am not competent to the task of throwing any osteological light upon these fossils, but am happy to state that Professor Owen has undertaken their examination; and we may therefore expect before long to be in possession of all that can be said about them. It seems to me not a little remarkable, that all these specimens should have been procured within a very narrow compass, for I found none beyond the limits of two contiguous indentations in the cliff, a short distance to the north of Felixstow.

But, to return to the concretions to which I am more particularly desirous of directing attention. They exhibit a very great variety of forms. Many are more or less spheroidal, fusiform, and cylindrical; many are perfectly amorphous. They appear to be composed of a fine-grained compact ferruginous claystone, of a dark chocolate brown colour; but the surface, which is very smooth, and even polished, becomes pale by exposure. They often separate by natural flaws into three or more fragments, which are bounded internally by nearly plane surfaces. Many of them offer traces of organic association; and the result of an extensive examination has convinced me that they must all be considered as of coprolitic origin. I am not aware whether any analysis has ever yet been made of them.

I will now direct attention to the following peculiarities observable in some one or other of the specimens referred to:—

1. Two spiral masses.
2. A large perforated one, with traces of spiral or annular transverse convolutions.
3. Other smaller ones, the convolutions being longitudinal.
4. Common character of the cylindrical and fusiform ones, seen, by fracture, to be formed of *longitudinally* coiled folds, with a perforated axis.

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